Office of Operating Experience Analysis, EH-33 • U.S. Department of Energy • Washington, D.C. 20585

OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

July 17 - July 23, 1998

Summary 98-29

Operating Experience Weekly Summary 98-29

July 17 through July 23, 1998

Table of Contents

Visit Our Web Site

The Weekly Summary is available, with word search capability, via the Internet at **http://tis.eh.doe.gov/web/oeaf/oe_weekly/oe_weekly.html**. If you have difficulty accessing the Weekly Summary at this URL, please contact the ES&H Information Center, 1(800) 473-4375 for assistance. If you have additional pertinent information or identify inaccurate statements in the summary, please bring this to the attention of I-Ling Chow, (301) 903-5984, or Internet address i-ling.chow@hq.doe.gov, so we may issue a correction.

EVENTS

1. 1998 OEWS READER SURVEY

NFS included the 1998 OEWS reader survey in Weekly Summaries 98-23 through 98-26. Your responses to the questions in the survey are needed to help us understand the needs of our customers and to chart the course for the OEWS and other OEAF products. If you have already submitted your survey form, we appreciate your response. If you have not, we urge you to do so no later than August 7, 1998. We will be tabulating the results shortly after that and will publish the results in a future issue of the OEWS.

KEYWORDS: OEWS, survey

FUNCTIONAL AREAS: Lessons Learned

2. CONTINUOUS AIR MONITOR CALIBRATION EXPIRED

On July 15, 1998, at the Los Alamos National Laboratory Chemistry and Metallurgy Research Facility, a radiological control technician performing a daily operability calibration discovered that the calibration date for a continuous air monitor had expired on June 10, violating facility operational safety requirements. He contacted a supervisor who verified that the monitor was out of calibration and directed facility personnel to replace it. The supervisor also directed radiological control technicians to verify the location, property numbers, and calibration dates of all facility-required continuous air monitors. Site Health Physics Measurement personnel performed operational/calibration tests on the monitor and determined that it was functioning properly. Health Physics Operations staff initiated a review of operational safety requirement surveillances and procedure-required daily checks of continuous air monitors to determine how facility personnel failed to notice the expired calibration. Failure to perform adequate surveillances led to an operational safety requirement violation and could have led to the undetected airborne contamination of workers. (ORPS Report ALO-LA-LANL-CMR-1998-0029)

Investigators determined that facility procedures require radiological control technicians to verify continuous air monitor operability and calibration dates (1) daily, before normal operations begin; and (2) weekly, as required by operational safety requirements. They determined that radiological control technicians verify current calibrations by checking the calibration stickers on the monitors and are required to replace any monitor that is due for calibration. Investigators determined that on April 20, a radiological control technician performed a weekly continuous air monitor surveillance and noticed that the calibration would expire on June 10. The technician decided to replace the monitor while demonstrating monitor replacements to a new radiological control technician. However, investigators determined that the technician replaced another continuous air monitor in the room, not the one he intended to replace. They also determined that the technician incorrectly identified the monitor he replaced in the operational safety requirement surveillance documentation. Therefore, the documentation incorrectly showed the uncalibrated monitor had been replaced. Investigators determined that none of the technicians who performed scheduled surveillances noticed that the calibration was about to (and subsequently did) expire.

The facility manager held a critique for this event. Meeting attendees learned that six radiological control technicians incorrectly initialed and dated cards indicating the successful completion of daily operability/calibration checks since the calibration expired on June 10. They also learned that Health Physics Measurement personnel distributed early warning alerts to Health Physics Operations instrument custodians to warn them that the monitor calibration was about to expire. Although Health Physics Measurement personnel distributed these alerts weekly for 3 weeks before the calibration expired, and weekly after it expired, Health Physics Operations personnel did not take any action to locate or calibrate the continuous air monitor. Based on data from two fixed-head air sample units and another continuous air monitor in the area, facility personnel determined that no radioactive material release occurred during the interval when the monitor was not calibrated. The facility manager directed Health Physics Operations personnel to take the following actions.

- Review on-the-job training records for facility radiological control technicians and determine if they received training on continuous air monitor operations and performance of daily monitor checks and weekly operational safety requirement surveillances.

- Retrain facility radiological control technicians on how to correctly perform daily monitor operability/calibration checks and weekly operational safety requirement surveillances.

- Review records of daily operability/calibration checks and weekly operational safety requirement surveillances performed in the last 6 weeks to determine whether surveillances were properly performed.

- Perform an independent verification of location, property numbers, and calibration dates for required continuous air monitors.

- Revise operational safety requirement surveillance procedures and documentation to improve the formality of surveillance performance.

NFS has reported inadequate surveillances in several Weekly Summaries. Following are some examples.

- Weekly Summary 98-07 reported that facility workers at the Mound Plant Tritium Facilities determined that a data-logging computer for radiation monitoring systems had been off-line for 9 days, even though the operational controls (authorization basis) manual for the facility required daily surveillance of the computer. (ORPS Report OH-MB-BWO-BWO01-1998-0003)

- Weekly Summary 98-05 reported two events involving inadequate surveillances. Facility personnel at the Hanford Tank Farm discovered that functional tests for the high-efficiency particulate air filter differential pressure interlocks and the stack high radiation alarm were not current. Investigators determined that no one entered facility safety documentation changes into the computerized planned maintenance system used to schedule surveillances. Fire protection personnel at the East Tennessee Technology Park K-25 Site discovered that a database contained no inspection records for five building sections. Investigators determined that, because of a programming error, no one scheduled or performed several monthly fire department walk-downs, monthly sprinkler system inspections, semiannual alarm tests, main drain tests, or annual fire extinguisher inspections. (ORPS Reports RL--PHMC-TANKFARM-1998-0010 and ORO--LMES-K25GENLAN-1998-0003)

- Weekly Summary 97-46 reported that fire protection personnel at the Rocky Flats Environmental Technology Site reviewed completed surveillances, performed a monthly surveillance, and did not notice a closed valve or see that several others were not locked open as required by the surveillance procedure. The building manager determined that this was an operational safety requirement violation because fire protection personnel failed to perform an adequate surveillance within the surveillance grace period. (ORPS Report RFO--KHLL-371OPS-1997-0097)

These events illustrate the importance of properly tracking and conducting surveillances. Proper performance of surveillances is important to ensure the availability and correct functioning of operational safety required systems. Equipment changes made as a result of calibration expiration should always be properly documented and independently verified to ensure that the correct configuration is maintained. DOE contractors who operate nuclear facilities and fail to conduct required surveillances or implement corrective actions for identified deficiencies could be subjected to Price-Anderson civil penalties under the work processes and quality improvement provisions of 10 CFR 830.120, *Quality Assurance Requirements*.

DOE facility managers should review their surveillance practices and ensure that personnel who perform surveillances clearly understand their responsibilities. They should also ensure that equipment replacement does not introduce configuration control errors. Facility managers should also review procedures that require independent verifications and surveillance requirements to ensure they are adequate to identify system discrepancies if they exist.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter VIII, “Control of Equipment and System Status,” states that managers at DOE facilities are required to establish administrative control programs to handle configuration changes resulting from maintenance, modifications, and testing. It also states that control of equipment and system status should be established in accordance with formal guidance to ensure the proper configuration is maintained.

- DOE O 5480.22, *Technical Safety Requirements*, attachment 1, describes the purpose of surveillance requirements and states that each surveillance shall be performed within the specified interval. General principle 1 states: "A system is considered operable as long as there exists assurance that it is capable of performing its specified safety function(s)." Surveillance testing is essential in providing this assurance.

- DOE-STD-1039-93, *Guide to Good Practices for Control of Equipment and System Status*, section 4.8, states that post-maintenance testing should verify that maintenance was performed correctly and that no problems were introduced as a result of the maintenance.

- DOE-STD-1050-93, *Guide to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities*, defines a post-maintenance test as any appropriate testing performed following maintenance to verify that (1) a particular piece of equipment or system performs its intended function based on its design criteria, (2) the original deficiency has been corrected, and (3) no new deficiencies are created.

- DOE/EH-0502, Safety Notice 95-02, "Independent Verification and Self-Checking," was issued in September 1995 and provides guidance and good practices for performing independent verifications. Safety Notice 95-02 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874. Safety Notices are also available on the OEAF Home Page at the following URL: http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: surveillance, test, inspection, compliance

FUNCTIONAL AREAS: Surveillance, Licensing/Compliance

3. SUBCONTRACTORS HELD ENERGIZED CABLES WHILE CUTTING CONDUIT

On July 7, 1998, at the Strategic Petroleum Reserves Bayou Choctaw Site, a construction manager discovered three subcontractor electricians holding potentially energized 480-volt power cables while cutting conduit with a band saw. The manager was performing routing monitoring activities when he noticed the electricians holding the cables away from the saw blade. He immediately directed the electricians to stop work and reported the event. Investigators determined that, although the electricians were trained and qualified, they cut the conduit in violation of their work permit and site safety procedures that require equipment to be locked out and tagged out. The subcontractor manager administered appropriate disciplinary actions. Failure to follow work permits and site safety lockout/tagout procedures could have resulted in the subcontractors being injured or in a fatality. (ORPS Report HQ--SPR-BC-1998-0003)

Investigators determined that the site is undergoing major life extension, including upgrading all electrical components. They determined that construction personnel issued the subcontractor electricians a work permit to remove conduit that contained 5-kv, motor-feeder cables at a high pressure pump pad. However, the construction manager saw the subcontractor electricians removing energized 480-volt power cables and realized they were cutting the conduit at the concrete grade with a band saw.

Subcontractor managers held an all-hands safety meeting to discuss the seriousness of this event. During the meeting, managers stressed that there is no reason for workers to perform any energized work on site. They also told workers that violations of site policies and procedures would not be tolerated. Investigators will continue to review this event and will determine further corrective actions as necessary.

NFS has reported similar lockout/tagout procedural violations in several Weekly Summaries. Following are some examples.

- Weekly Summary 98-16 reported that a union steward at the Nevada Test Site discovered a wireman replacing 110-volt breakers inside an energized 480-volt panel without a lockout/tagout or personnel protective equipment. (ORPS Report NVOO--LANV-NTS3-1998-0001)

- Weekly Summary 97-45 reported five lockout/tagout events. Facility personnel at the Savannah River Site approved a valve lockout without adequately establishing and addressing system boundaries. A utility engineer at the Fernald Environmental Management Project discovered that a services interruption permit (similar to a lockout/tagout) had improper change authorizations. An electrician at Sandia National Laboratory removed a lockout and reconnected the electrical load without authorization. OSHA inspectors observed that millwrights at Oak Ridge National Laboratory had not re-verified a single-point lockout before resuming repair work. Maintenance mechanics at the Idaho National Engineering and Environmental Laboratory installed a lockout/tagout on an instrument air line, then cut an adjacent but incorrect, air line. (ORPS Reports ALO-KO-SNL-NMFAC-1997-0016, SR--WSRC-SEPGEN-1997-0004, OH-FN-EDF-FEMP-1997-0048, ORO--ORNL-X10PLEQUIP-1997-0011, ID--LITC-SMC-1997-0007)

These events illustrate the need for facility managers to ensure that contractors and subcontractors understand and follow work control and configuration management programs. In this event, the construction manager's routine monitoring of subcontractor activities identified a hazardous situation and his actions might have prevented three fatalities. This, combined with the subcontractor manager's intolerance for workers who perform unapproved energized work, indicates that a strong site management structure and good communication with contractor and subcontractor organizations exists. Facility managers are ultimately responsible for ensuring successful completion of work activities. Routine monitoring of contractor and subcontractor work by facility managers and supervisors will help ensure that electrical work is conducted in accordance with facility policy and procedures. In addition, safety and health hazard analysis must be included in the work control process to help prevent worker injury. Prejob briefings, facility procedures, and training programs should emphasize the dangers associated with electrical activities.

Lockout/tagout programs in DOE serve two functions. The first function, defined in both 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities,* is to protect personnel from injury and protect equipment from damage. The second function is to provide overall control of equipment and system status. Lockout/tagouts are typically applied during maintenance activities; however, there are many cases when lockout/tagouts are needed for personnel safety. The standard states that an effective lockout/tagout program requires three elements. These elements are as follows: (1) all affected personnel must understand the program; (2) the program must be applied uniformly in every job; and (3) the program must be respected by every worker and supervisor. A good lockout/tagout program is an important element of an effective conduct of operations program.

DOE facility managers should ensure that personnel understand the basics of work control practices, work planning, and safety and health hazard analysis. Facility managers should review the following references for guidance on lockout/tagout and facility safety programs.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, states that DOE policy is to operate DOE facilities in a manner to ensure an acceptable level of safety and that procedures are in place to control conduct of operations. Chapter VIII, "Control of Equipment and System Status," provides an overall perspective on control of equipment and system status. Specific applications of system control are addressed in chapter IX, "Lockout/Tagout," and chapter X, "Independent Verification."

- DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, provides guidance on lockout/tagout program implementation and management at DOE facilities.

- DOE/EH-0540, Safety Notice 96-05, "Lockout/Tagout Programs," summarizes lockout/tagout events at DOE facilities, provides lessons learned and recommended practices, and identifies lockout/tagout program requirements. Safety Notice 96-05 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874. Safety Notices are also available on the OEAF Home Page at URL: http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html.

- DOE/ID-10600, *Electrical Safety Guidelines*, prescribes DOE safety standards for the use of electrical energy at DOE field offices or facilities. Section 2.13.1.3 states that when circuits and equipment are worked on they must be disconnected from all electrical energy sources. These guidelines are intended to protect personnel from electrical shock and potential fatalities.

- DOE/ID-10447*, Construction Safety Reference Guide*, section B.8, discusses requirements for a lockout/tagout program for construction activities. This section of the guide endorses OSHA regulations contained in 29 CFR 1910.147, "The Control of Hazardous Energy (Lockout/Tagout)," and indicates where OSHA training requirements are mandatory.

The *Hazard and Barrier Analysis Guide*, developed by OEAF, includes a hazard-barrier matrix that shows that lockout/tagout is the most effective barrier against injury. When implemented properly, lockout/tagout provides a high probability (greater than 99 percent) of success for risk reduction. A copy of the Hazard and Barrier Analysis Guide is available at URL: http://tis.eh.doe.gov:80/web/oeaf/tool/hazbar.pdf.

KEYWORDS: electrical, lockout and tagout, construction, procedures

FUNCTIONAL AREAS: Industrial Safety, Hazards Analysis, Lessons Learned

4. FLUSH-MOUNTED PENDANT SPRINKLERS FAIL TO OPERATE

On June 29, 1998, at the Argonne National Laboratory-East, fire protection engineers discovered a corrosion problem affecting flush-mounted pendant sprinkler heads. Engineers conducted preliminary testing of 26 sprinkler heads. This testing showed that corroded sprinkler heads were unlikely to operate at the design pressure. Fire protection engineers have identified two corrosion-related failure modes. In some sprinklers, corrosion resulted in the deflector failing to drop when the link was fused; in others, the fusible link mechanism failed to separate when the link was fused. Investigators are conducting preliminary assessments to determine the extent and causes of the corrosion problem. Most corroded sprinklers do not show any visible signs of corrosion until the link is fused and the deflector cover plate is removed. Laboratory managers contracted for additional fire protection engineering support to help conduct field assessments and arranged for Underwriters Laboratories, Factory Mutual Laboratories, and the manufacturer to perform further testing to determine whether there is a manufacturing defect or a site-specific problem. Site-specific problems may include poor installation practices or contaminants in the site water supply. OEWS engineers will continue to follow the investigation and will report their findings in a future Weekly Summary.

KEYWORDS: corrosion, fire protection, sprinkler

FUNCTIONAL AREAS: Fire Protection

5. LOSS OF SEALED SOURCE ACCOUNTABILITY

On July 20, 1998, at the Oak Ridge National Laboratory Radiochemical Engineering Development Center, a radiochemical employee discovered an incorrectly tagged sealed source. The source was tagged as californium; however, it was actually an americium/beryllium source that was shipped from the Fusion Energy Division on June 26, 1998. The radiochemical employee notified Fusion Energy Division personnel of the discrepancy. Fusion Energy Division personnel determined that the californium and americium/beryllium tags were incorrectly switched sometime in the late 1980s and neither source was used after the switch. Facility personnel confirmed that Fusion Energy Division personnel shipped the californium source to the Waste Management Division in September 1997, and it is still in retrievable storage. Lack of sealed source accountability can result in lost sources, improperly discarded sources, and failed source integrity and can lead to the spread of contamination and personnel exposures.(ORPS Reports ORO--ORNL-X10FUSIONE-1998-0002 and ORO--ORNL-X10FUSIONE-1998-0003)

Investigators determined that as part of a project to inventory and dispose of unused sources, Fusion Energy Division personnel returned the loaned americium source (tagged as californium) to the Radiochemical Engineering Development Center. They determined that, when the radiochemical employee unpacked the returned source to put it into the facility inventory, he recognized that it was not californium because of its size and shape and based on his knowledge of californium sources. Investigators determined that both sources were properly stored, packaged, and surveyed. However, because both sources are neutron emitters, no one detected the tag discrepancies during the shipping process. Investigators also determined that the mis-labeling of both sources during shipment from the Fusion Energy Division are potential Department of Transportation violations. The facility manager continues to review this event and will develop corrective actions as necessary.

NFS has reported on source accountability in several Weekly Summaries. Following are some examples.

- Weekly Summary 98-26 reported that a nondestructive analysis worker at Rocky Flats Environmental Technology Site Non-Plutonium Operations Area III lost a 3.5-microcurie barium check source when he left it unattended. Investigators believe that operations personnel accidentally swept up the source along with other debris and that sanitary workers employed by a private sanitary waste company may have transported it to an off-site landfill. (ORPS Report RFO--KHLL-NONPUOPS3-1998-0003)

- Weekly Summary 98-06 reported that a facility manager at the Rocky Flats Environmental Technology Site reported loss of accountability of a sealed, 150-mCi tritium source contained in an electron-capture detector and installed in a gas chromatograph. Property utilization and disposal personnel received the gas chromatograph from the plutonium manufacturing and assembly complex, opened it, discovered the source, and notified radiological control personnel because they recognized the trefoil symbol. (ORPS Report RFO--KHLL-FACOPS-1998-0002)

- Weekly Summary 97-34 reported that a facility manager at the Sandia National Laboratory discovered that a gas chromatograph containing a 150-mCi tritium source was not registered in the site source registry. Investigators determined that a source custodian did not register it when it was received from the manufacturer, resulting in a loss of accountability of the sealed source. (ORPS Report ALO-KO-SNL-6000-1997-0007)

OEAF engineers searched the ORPS database for events with all narrative of sealed sources from January 1990 to present and found 89 occurrences. Figure 5-1 shows the distribution of root causes for these events. A review of these occurrences shows that managers reported 41 percent of the root causes as management problems, 18 percent as personnel errors, and 16 percent as procedure problems. Further review of the management problems shows that 49 percent were reported as inadequate administrative control, and 38 percent were reported as policy not adequately defined, disseminated, or enforced. Further review of the personnel errors shows that 43 percent were reported as inattention to detail. Further review of the procedure problems shows that 64 percent were reported as defective or inadequate procedure.

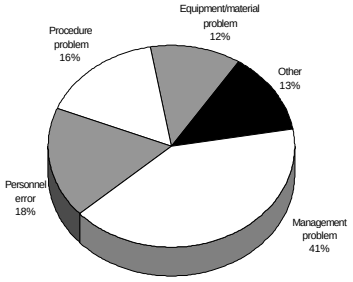

Figure 5-1. Root Causes for Sealed Source Occurrences [1]

These events emphasize the importance of strict accountability of radioactive sources and demonstrate the need for a strong radioactive source control program. DOE maintains a regulatory position paper on sealed radioactive source controls. The position paper states: "these requirements were determined to be necessary for an adequate radiation protection program." Personnel responsible for radioactive source control at DOE facilities should ensure their source control program includes the following elements from DOE N 441.1 through DOE N 441.3.

- administrative procedures for the control of accountable sealed radioactive sources
- labels on all accountable sources, or their storage containers or devices, with the standard radiation warning trefoil and the words, "Caution, Radioactive Material"
- an individual designated to maintain control of assigned accountable sources (The individual shall be trained as a radiological worker in accordance with 10 CFR 835.902 and instructed on site-specific source control procedures.)

[1] OEAF engineers searched the ORPS database using the graphical users interface for reports that contained all narrative of "sealed source" from January 1990 to present and found 89 occurrences. Based on a random sampling of 20 events, OEAF engineers determined that each slice is accurate within ± 1.0 percent.

- periodic inventory of each accountable source at intervals not to exceed 6 months (The inventory should verify (1) physical location of each source, (2) adequacy of postings and labels, and (3) adequacy of storage locations, containers, and devices.)

- integrity test of each source (with an activity exceeding 0.005 µCi) upon receipt, when damage is suspected, and at intervals not to exceed 6 months

Personnel working at DOE facilities should have a continually questioning attitude toward safety issues. Each individual is ultimately responsible for complying with rules to ensure personal safety. Facility managers should communicate a sound policy stressing that safety is of prime importance and that all personnel must exhibit an individual commitment to excellence and professionalism. Personnel in charge of shipping and storing radioactive sources should review the following guidance and should ensure that sources are properly shipped, correctly labeled, and stored in physical locations that prevent personnel exposure.

- DOE/EH-256T, *Radiological Control Manual,* requires control and accountability of sealed radioactive sources. It states that each person involved in radiological work is expected to demonstrate responsibility and accountability through an informed, disciplined, and cautious attitude toward radiation and radioactivity. The manual sets forth DOE guidance on the proper course of action in the area of radiological control, including work preparation; work controls; monitoring and surveys; and training and qualifications. Section 123, "Worker Responsibilities," states that trained personnel should recognize that their actions directly affect contamination control, personnel radiation exposure, and the overall radiological environment associated with their work.

- DOE N 441.3, *Radiological Protection for DOE Activities*, requires control and accountability of sealed radioactive sources. However, this notice applies only to defense nuclear facilities. The majority of pertinent radiological protection requirements have become codified through promulgation of 10 CFR 835, *Occupational Radiation Protection*. Currently, 10 CFR 835 does not address sealed radioactive source accountability; however, it will be addressed in a pending amendment. Facility managers should refer to DOE/EH-256T, *Radiological Control Manual,* for information on the control and accountability of sealed radioactive sources.

- DOE Implementation Guide G-N 5400.9/M1-Rev.1, *Sealed Radioactive Source Accountability and Control*, provides guidance for establishing and operating a sealed source accountability and control program. Specific guidance includes organization and responsibilities, receipt, labeling and storage, inventory, integrity testing, and handling and disposal.

Links to DOE radiation protection documents can be found at URL http://tis-nt.eh.doe.gov/wpphm/regs/regs.htm.

KEYWORDS: sealed source, transportation

FUNCTIONAL AREAS: Radiation Protection, Transportation, Licensing/Compliance

6. PIPEFITTER DRILLS INTO DRAIN LINE

On July 13, 1998, at the Idaho National Engineering and Environmental Laboratory, a maintenance pipefitter drilled through an interior wall into a sanitary water drain line and nearly hit an electrical conduit. The pipefitter used a work order, but no one followed work order instructions to obtain a sub-surface survey before starting work Failure to perform sub-surface surveys before drilling into surfaces exposes workers to unidentified hazards and could result in building service interruptions. (ORPS Report ID--LITC-LANDLORD-1998-0023)

Investigators determined that attendees of the pre-job briefing did not discuss the work order requirement for a sub-surface survey. They also determined that the pipefitter was unaware of how a sub-surface survey permit applied to the work because he believed that it only applied to ground-penetration work. The facility manager ordered immediate actions that included stopping work and isolating water to the drain line.

NFS has reported similar occurrences where workers penetrated interior building surfaces, resulting in damage to unidentified services and exposure to hazardous energy in several Weekly Summaries. Following are some examples.

- Weekly Summary 97-11 reported that a subcontract worker at Brookhaven National Laboratory struck an energized 120-volt electrical cable while drilling into a concrete floor. Investigators determined work planners did not identify the location of the cable before drilling started. (ORPS Report CH-BH-BNL-PE-1997-0003)

- Weekly Summary 96-42 reported that jackhammer operators struck three conduits while working on a concrete dock inside a building at the Rocky Flats Environmental Technology Site. The subcontractor assumed that the prime contractor had verified that no utilities were located beneath the concrete. (ORPS Report RFO--KHLL-REGWSTOPS-1996-0005)

- Weekly Summary 96-04 reported that a mason tender at Los Alamos National Laboratory received a severe electrical shock that resulted in serious burns and cardiac arrest. The mason tender was excavating in a building basement when the jackhammer he was operating contacted an energized 13.2-kV electrical cable. (*Type A Accident Investigation Board Report on the January 17, 1996, Electrical Accident with Injury in Building 209, Technical Area 21 Los Alamos National Laboratory*; ORPS Report ALO-LA-LANL-TSF-1996-0001)

- Weekly Summary 92-24 reported that a construction worker at the Mound Plant drilled into an electrical line but avoided injury because he used good safety practices. Before initiating the work, facility personnel issued a penetration permit that included a review of the building drawings and an instrumentation scan of the work area to check for the presence of embedded electrical lines. Although no such lines were located, the construction inspector recommended the use of protective rubber gloves and boots as an additional precaution. (ORPS Report ALO-DA-EGGM-EGGMAT04-1992-0010).

These events underscore the importance of using effective work control practices and detailed pre-job planning. Pre-job briefings, facility procedures, and training programs should emphasize the dangers associated with penetrating building surfaces. Work packages must be detailed enough to clearly identify permitting requirements and must clearly state who is responsible for securing permits. Planners must use all available drawings and should consider conducting detailed walk-downs to ensure utilities are identified. In locations where configuration knowledge

is limited, use of metal detectors or other methods should be considered to confirm utility locations before penetrating building surfaces. Following are some references that facility managers, program and project managers, and project personnel should review to ensure they are incorporated in the surface-penetration permitting process.

- DOE O 4330.4B, *Maintenance Management Program*, section 8.3.1, provides guidelines on work control systems and procedures. The Order states that work control procedures help personnel understand the necessary requirements and controls.

- DOE-STD-1050-93, *Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities*, provides information on work controls and work coordination. This reference can be applied to all facilities.

- 29 CFR 1926, *Safety and Health Regulations for Construction,* paragraphs .651(b) and .416(a)(3), assign employers responsibility for identifying energized circuits near the work area.

KEYWORDS: construction, hazard analysis, permit, pre-job planning

FUNCTIONAL AREAS: Construction, Industrial Safety, Hazards Analysis, Work Planning

7. ELECTRICIAN OBSERVES ELECTRICAL ARC AND FIREBALL WHILE WORKING NEAR ENERGIZED CIRCUITS

On July 16, 1998, at the Hanford Site N-Reactor, an electrician observed an electrical arc and fireball while disconnecting circuit leads from a 480-volt motor control center. The fireball resulted after a bare ground-wire came in contact with the exposed, energized feeder bus in the motor control center. Damage was limited by the quick tripping of the upstream 480-volt feeder breaker. The electrician was wearing eye protection and rubber gloves in accordance with an energized electrical work permit and was not injured Although the electrician was not injured, there was potential for serious injury. (ORPS Report RL--BHI-NREACTOR-1998-0020)

Workers use energized electrical work permits when it is not feasible to de-energize critical electrical equipment before working on it. Investigators determined that the approval authority for the energized electrical work permit did not identify any critical loads on the motor control center and did not walk-down the work before approving the permit. They determined that the motor control center is used to provide power to a basin de-watering pump and a continuous air monitor. The pump was not required to operate at the time of the incident, and the continuous air monitor could have been powered from another source during work on the motor control center. The electrician reset the breaker and restored power to the pump and continuous air monitor.

NFS has reported similar events involving accidents while working near electrically energized equipment. Following are some examples and a summary of a similar ORPS report.

- Weekly Summary 98-17 reported that riggers at the Hanford Site 221-U Canyon were replacing the wire rope on a 75-ton bridge crane when one end contacted an exposed, energized, 480-volt electrical bus, causing an arc. Investigators determined that the activity hazard analysis did not identify the energized bus as a hazard. (ORPS Report RL--BHI-IFSM-1998-0005)

- Weekly Summary 97-44 reported that two subcontractor electrical workers at Fermi National Accelerator Laboratory received flash burns from an electrical arc blast when a metal cover contacted an energized bus bar as they attempted to connect a neutral cable for a temporary feed from a 480-volt motor control center panel. Emergency response personnel responded to the scene and sent one of the subcontractors to a local hospital by ambulance. He was treated for burns to his hands and immediately released. The second subcontractor was transported by helicopter directly to a hospital with a burn unit where he was treated for burns to his face and hands. (*Type B Accident Investigation Board Report on the October 22, 1997, Electrical Arc Blast at Building F-Zero Fermi National Accelerator Laboratory Batavia, Illinois*, November 1997; and ORPS Report CH-BA-FNAL-FERMILAB-1997-0004)

- On January 12, 1998, a wireman at the Nevada Test Site failed to apply a craft lock to a circuit breaker or wear the correct personnel protective equipment when he tightened a loose circuit wire splice, and it arced to ground when his pliers contacted the side of a junction box. Investigators determined that procedures did not require electricians to check for zero voltage on both sides of a splice before performing work. Corrective actions included requiring craft personnel to attend electrical safety refresher training and reminding wiremen to use appropriate lockout/tagout devices. (ORPS Report NVOO--BNLV-NTS-1998-0002)

This event illustrates the importance of conducting thorough pre-job planning, including an activities hazard analysis of all anticipated work activities. Conducting a hazard analysis would have shown that the control center needed to be electrically isolated with a lockout/tagout.

Facility managers, work planners, and crafts personnel should review the following references, which provide guidance and good practices for planning electrical work.

- DOE-STD-1050-93, *Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities,* provides guidance to maintenance organizations to ensure that work package planning, scheduling, and coordination identifies all technical and administrative requirements for a work activity to be safely and effectively completed.
- 29 CFR 1910 Subpart S, *Electrical*, describes work practices to be employed to prevent injuries when work is performed near or on equipment or circuits which are or may be energized.

- 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities,* provide guidance on the implementation of effective lockout/tagout programs. These references both state that the primary purpose of a lockout/tagout program is to protect personnel from injury and protect equipment from damage. The second function is to provide overall control of equipment and system status.

- DOE/ID-10600, *Electrical Safety Guidelines*, prescribes electrical safety standards for DOE field offices and facilities. Included in the guidelines is information on training and qualifications, work practices, protective equipment, insulated tools, and recognition of electrical hazards.

- DOE-HDBK-1092-98, *Electrical Safety*, contains explanatory material in support of OSHA regulations and nationally recognized electrical safety-related standards. This document addresses electrical safety for enclosed electrical and electronic equipment and discusses the latest editions of 29 CFR 1910 and 1926 and National Fire Protection Association Standard 70E, “National Electrical Code.”

- The *Hazard and Barrier Analysis Guide*, developed by OEAF, discusses barriers that control job-associated hazards, such as physical barriers, procedural or administrative barriers, or human action. The reliability of a barrier is determined by its ability to resist failure. Barriers can be imposed in series to provide defense-in-depth and to increase the margin of safety. The guide includes a hazard-barrier matrix that shows that lockout/tagout is the most effective barrier against injury. When implemented properly, lockout/tagout provides a high probability (greater than 99 percent) of success for risk reduction. The guide provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

A copy of *The Hazard and Barrier Analysis Guide* may be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874.

KEYWORDS: breaker, electrical safety, hazard analysis, near miss, work planning

FUNCTIONAL AREAS: Electrical Maintenance, Hazards and Barrier Analysis, Work Planning